

Serial No: 10/741,535

Carl L. Willis et al.

Attorney Dkt. No.
KPR-TH-1552US**REMARKS**

This is a full and complete response to the Office action dated February 23, 2006.

Disposition of the Claims:

Claims 1-8 and 10-31 are pending in the application. Claims 1-8 and 10-17 are rejected and claims 18-31 are withdrawn.

Amendments to the Claims:

Claim 1 has been amended to include subject matter from claim 9. Claim 10 has also been amended.

All comments and remarks of record are herein incorporated by reference. Applicant respectfully traverses these rejections and all comments made in the Office action. Nevertheless, in an effort to expedite prosecution, Applicant provides the following remarks regarding the cited references.

Remarks Regarding 35 U.S.C. §102(b)

Claims 1-10 and 12-17 stand rejected, under 35 U.S.C. §102(b) as allegedly anticipated by De LaMare (US 3,830,880). Applicant respectfully traverses this rejection.

The claimed invention is directed to a process for preparing a conjugated diene polymer or copolymer block having a varying amount of branching comprising combining (a) an anionic polymerization site, (b) a conjugated diene monomer, and (c) a microstructure control agent under reaction conditions sufficient to form a living polymer admixture and, at a point in the process prior to the completion of the polymerization of the conjugated diene monomer, combining the living polymer admixture with a microstructure control agent deactivant to mitigate or eliminate the effect of the microstructure control agent. Applicant has amended claim 1 to include certain aspects of claim 9. Accordingly, amended claim 1 further includes the aspect wherein the microstructure control agent deactivant is an aluminum alkyl compound having from 1 to 20 carbon atoms per alkyl substituent and mixtures thereof.

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The Examiner alleged that **De LaMare** specifically teaches the reaction of dienes through living polymerization with the addition of a microstructure control agent, and the deactivation of this control agent using diethyl zinc during the polymerization. However, the Examiner also stated that **De LaMare** does not teach the use of triethyl aluminum as a deactivation agent.

Applicant respectfully asserts further that **De LaMare** does not disclose or suggest the use of any aluminum alkyl compound as a deactivation agent. Moreover, **De LaMare** does not disclose or suggest a microstructure control agent deactivant that is an aluminum alkyl compound having from 1 to 20 carbon atoms per alkyl substituent and mixtures thereof. In fact, **De LaMare** only teaches compounds of Group II metals of the periodic table, which does not include aluminum alkyl compounds, as suitable for his invention. Therefore, **De LaMare** does not disclose or suggest the claimed invention. In consequence, Applicant respectfully submits that claims 1-10, and 12-17 are not anticipated or suggested by **De LaMare**.

Remarks Regarding 35 U.S.C. §103(a)

Claim 11 stands rejected, under 35 U.S.C. §103(a), as allegedly obvious over **De LaMare** in view of **Willis et al.** (US 6,103,846).

Claim 11 recites that the microstructure control agent deactivant is triethylaluminum. Amended claim 1 is also directed to microstructure control agent deactivant which is an aluminum alkyl compound having from 1 to 20 carbon atoms per alkyl substituent.

The Examiner alleges that, although **De LaMare** does not teach the use of triethyl aluminum as the deactivation agent in his process, the equivalence of triethyl aluminum to diethyl zinc in reactions involving living polymerization is known and specifically taught in **Willis et al.** Applicant respectfully disagrees.

Although **Willis et al.** does mention the use of trialkyl aluminum as well as dialkyl zinc compounds, they have a completely different function than in the current invention.

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Willis et al. is directed to the preparation of di- or polyfunctional polymers by anionic polymerization using functionalized initiators. Willis et al. employs termination inhibitors to inhibit undesirable terminating side reactions which can occur with the use of the functional initiators. See Willis et al., column 1, lines 60-63; column 2, lines 50-53. It is in this function, as termination inhibitors, that Willis et al. uses metal alkyls such as trialkyl aluminum and dialkyl zinc. The inhibition of the terminating side reactions occurs as a result of a living polymer chain reacting reversibly with a metal alkyl inhibitor. See Willis et al. column 4, line 56 to column 5 line 33. This is not Applicant's claimed invention.

Willis et al. does not teach the equivalence of triethyl aluminum to diethyl zinc. The reference merely discloses that metal alkyls such as trialkyl aluminum or dialkyl zinc, or others, may be used as termination inhibitors for the kinds of initiators as disclosed in Willis et al. For example, in Example 1 of Willis et al., it is stated that "[t]he purpose of the added TEA was to inhibit the rate of addition of the chain ends to the added Si-O moiety." See Willis et al., column 9, lines 21-23. This results in inhibition of the undesirable termination reactions.

The reference does not disclose the use of alkyl metals for use as microstructure control deactivants and, accordingly, does not suggest to one skilled in the art that alkyl aluminum can be substituted for diethyl zinc. Such a disclosure does nothing to teach one of ordinary skill in the art what may be used as a microstructure control deactivant. Further, there is also no motivation provided by the references to substitute triethyl aluminum for diethyl zinc.

Equivalence in many types of reactions

The Examiner further alleges that the alleged equivalence between diethyl zinc and triethyl aluminum is known in many types of reactions. Applicant respectfully disagrees.

The claimed invention is drawn to the use of aluminum alkyls for deactivation of the microstructure modifier. Aluminum belongs to Group III of the Periodic Table of Elements, whereas zinc is in Group II. In the Periodic Table of Elements, Group II

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elements are separated from Group III elements because they have different properties. For at least this reason, the compounds of these elements are generally held to have different properties and are not necessarily interchangeable.

For example, one of skill in the art would not expect aluminum trialkyl compounds to have the same Lewis acidity as the dialkyl zinc. If the acidities of the various alkyls are different, it is reasonable to expect that the interactions of the two different groups of Lewis acids, such as aluminum alkyls versus Group II zinc alkyls, with the three groups of Lewis bases that are present in the reaction medium as described in the present application, namely 1) the chelating ether microstructure modifiers, 2) the carbanionic living polymer chain ends and 3) the monomer(s), will be different.

Differences in these interactions would be expected to affect the ability of the deactivant to operate on the microstructure modifier in an effective manner.

For example, to the extent that the aluminum alkyl preferentially interacts with either the carbanionic living polymer chain end or the monomer, it would not have been available to interact with the chelating ether microstructure modifier and could not have performed as a microstructure deactivant. In Willis et al. as described above, the aluminum alkyl preferentially interacts with the living polymer chain end.

The acidity of the deactivant aluminum alkyl will also affect the activity of the propagating anionic chain end, a strong Lewis base. As a result, deactivation of the living chain end by the addition of the Lewis acid is possible. Further, complete termination of polymerization was a possibility if the interaction of the aluminum alkyl with the living chain end were too strong. Clearly, if the deactivant induced termination of anionic polymerization, the claimed invention would not have been possible.

The exchange of alkyl moieties between the metal alkyl deactivant and the Li-C polymer chain end was also a possibility. The synthesis of well defined block copolymers using anionic polymerization techniques relies upon the retention of the identity of the living anionic polymer chain ends throughout the polymerization process. Transfer of the growing anionic polymer chain end of the metal alkyl deactivant during the polymerization reaction would have confounded the synthesis of a block copolymer. If this exchange reaction were relevant under polymerization conditions, the claimed invention also would not have been possible.

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In view of the foregoing, Applicant respectfully asserts that it would in no way be obvious to one of skill in the art to substitute trialkyl aluminum of Willis et al. for the diethyl zinc of De LaMare.

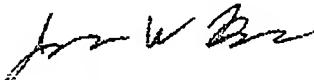
Accordingly, and in view of Applicant's remarks above, Applicant respectfully requests that the rejection of claim 11, under 35 U.S.C. § 103(a) be withdrawn.

If further explanation is required, Applicants respectfully request an interview with the Examiner.

Conclusion

Having addressed all issues set out in the Office action, Applicant respectfully submits that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,
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